Contradicting Incentives for Research Collaboration

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Abstract

This study describes the Danish publication award system (BFI), investigates whether its built-in incentives have had an effect on publication behavior at the University of Southern Denmark, and discusses the possible future implications on researcher incentives should universities wish to measure BFI on the individual level. We analyzed publication data from the university CRIS system (Pure) and from SciVal. Several studies indicate that co-authored scholarly journal articles attract more citations than single author articles. The reason for this are not clear, however, research collaboration across institutions and countries is commonly accepted in the research community and among university managements as one way of increasing the researcher's and institution's reputation and impact. The BFI system is designed to award scholarly publication activity at Danish universities, especially publication in international journals of high status. However, we find that the built-in incentives leave the researcher and his or her institution with a dilemma: If the researchers optimize their performance by forming author groups with external collaborators, the optimal way of doing so for the researchers is not the optimal way seen from the perspective of the university. Our analysis shows that the typical article has 6.5 authors, two of which are internal, and that this has remained stable since the introduction of the BFI. However, there is variation across the disciplines. While 'the Arts and Humanities' and 'the Social Sciences' seem to compose author groups in a way which does not optimize the performance of the institution, both 'Health' and 'the Natural Sciences' seem to optimize according to criteria other than those specified in the BFI.

Keywords: Reward Systems – Denmark - Incentives Effects – Case Study

Introduction

The Danish Bibliometric Research Indicator (BFI) is part (25 percent) of the performance-based model for the distribution of a special pool of baseline funding for Danish universities and public research institutions BFI rewards research publications published in the most prestigious scientific journals (Sievertsen and Schneider 2012:24ff). The Danish BFI system is based on the Norwegian model from 2006 (Sievertsen and Schneider 2012:28, Haugen and Sandnes 2016). Other Nordic countries, such as Finland, have adopted similar models, so that one might speak of a common Nordic BFI (Sievertsen and Schneider 2012:27-28). Since there are some minor differences between the models, in this article we will restrict ourselves to discussing the Danish BFI exclusively.

In the Danish system, publication channels are divided into so-called authority lists of series (conference series, book series and journals) and publishers (Sievertsen and Schneider 2012-28). The lists are prepared and audited periodically and are divided into tiers: In Denmark the system currently employs a normal tier 1 and a high tier 2. Publishing in series from tier 2 earns more credit than publishing in series from tier 1[i]: An article published in a tier 2 journal is normally awarded 3 credits, while an article in a tier 1 journal is awarded 1 credit. Every year the amount of credits earned by each institution is calculated and exchanged for

[1] We thank the anonymous reviewers at Scientometrics for some very useful comments for an earlier version of this work

governmental funding. In this way, the system has created incentives for the universities to carefully monitor the publication patterns of their faculty and to strengthen policies that award researchers according to the BFI credit they earn. Thus, incentives are also indirectly created for the individual researcher to optimize their own BFI. So far, calculating BFI credit on the individual level has not been the formal policy of the universities (Sievertsen and Schneider 2012:19, Aagaard, Bloch et al. 2014). However, such calculations can be and are being made on a regular basis though the research information system PURE (Elsevier), a system which has been adopted by all Danish universities. In fact, some universities use BFI calculations for internal distribution of funds (Sievertsen and Schneider 2012:29). Furthermore, there is reason to suspect that this is becoming increasingly common, and that research indicators like the h-index and probably also BFI are included in considerations on hiring or firing or which employees to promote and how to allocate resources in academia in Denmark (Aagaard, Bloch et al. 2014: 76-77) . In conclusion we concur with Aagaard, Bloch et al. (2014:9) when they argue that 'it is in practice quite difficult to maintain that the Publication Indicator is only designed for use at an aggregated level'.

Although the calculation of BFI credits seems straightforward, individual researchers are faced with some dilemmas related to optimizing: we argue here that the system contains contradicting incentives. The way that BFI credits may be optimized are different for the individual researcher and for the institutions. The purpose of this article is to describe and discuss the contradicting incentives related to the allocation of BFI credits for co-authored articles.

The Danish BFI was implemented in 2009, with budgetary effects from 2010. It was evaluated only two years later (Sievertsen and Schneider 2012). Overall, the evaluation was positive, and in fact evaluators saw many positive effects of the BFI and hardly any negative effects on publication patterns. The quantity and quality of research output were increasing, and much of the initial resistance among researchers slowly disappeared (Sievertsen and Schneider 2012:10-11). One of the most promising results of the evaluation was that the data indicated increased cooperation between researchers across national and institutional borders. According to the evaluators this was no coincidence; it was rather a result of built-in incentives of the BFI to cooperate. This was good news, since one of the political goals in establishing the BFI system was to encourage cooperation between researchers across institutions and countries.

Background

It can be argued that it is in the strategic interest of Danish universities to cooperate internationally, since it is expected that co-authoring will contribute significantly to raising the status and impact of Danish research – at least for the fields of science, technology and medicine (STM). The possible citation advantage for co-authored publications has been debated and studied in the bibliometric community; however, many bibliometric studies indicate a citation advantage for co-authored publications, whose extent may be limited and may vary across subject areas (Costas and Bochove, Aksnes 2003, Bartneck and Hu 2010, Sin 2011, Hurley, Ogier et al. 2013, Pislyakov and Shukshina 2014, Thijs, Costas et al. 2015).

In the BFI-system, the incentive to cooperate is a 25 percent bonus for co-authored publications if authorship is shared between two or more institutions (Sievertsen and Schneider 2012:19). This means that if a researcher from the University of Southern Denmark (i.e. internal author) writes a tier-2 article with a colleague from the University of Copenhagen (external author) the article is awarded a bonus of 25 percent (1.25*3 credits) for the two universities to share. After the bonus has been added, the universities share the total credits between

them. This is called fractioning of credits [*fraktionering*]. The intention of the bonus is not only to encourage cooperation, but also to counteract a distortion in the allocation of BFI credits to areas where co-authoring is more prevalent than in others (Faurbæk 2013). The Norwegian system did not originally contain a similar bonus system. However, in order to increase incentives for Norwegian researchers to cooperate, a similar bonus system was introduced in 2016 (Haugen and Sandnes 2016).

On top of this, a minimum limit for how few credits a university can earn from a tier-2 publication is set at 0.1. This means that if an article has more than 38 authors at more than 38 different institutions, each individual institution will still be awarded 10 percent of the amount of credits obtained by the publication (Faurbæk 2008). Publications rarely have 38 authors. The average number of authors per article at our case university (University of Southern Denmark) is 6.5. A more likely scenario would therefore look like this: For a tier-2 article written by six authors, five of whom work for the same institution while one works for another, the first university will receive (3.75 / 6) * 5 = 3.125. This is 0.125 points more than the university would have received, had the article been written by internal authors only (see Table 1).

Table 1. No. of BFI credits awarded the institution for a level 2 article with multiple authors from different institutions.

	No. of external authors									
No. of internal authors	0	1	2	3	4	5	6	7	8	9
1	3.00	1.88	1.25	0.94	*0.75*	*0.63*	*0.54*	*0.47*	*0.42*	*0.38*
2	3.00	2.50	1.88	1.50	1.25	1.07	0.94	0.83	*0.75*	*0.68*
3	3.00	2.81	2.25	1.88	1.61	1.41	1.25	1.13	1.02	0.94
4	3.00	3.00	2.50	2.14	1.88	1.67	1.50	1.36	1.25	1.15
5	3.00	**3.13**	2.68	2.34	2.08	1.88	1.70	1.56	1.44	1.34
6	3.00	**3.21**	2.81	2.50	2.25	2.05	1.88	1.73	1.61	1.50
7	3.00	**3.28**	2.92	2.63	2.39	2.19	2.02	1.88	1.75	1.64
8	3.00	**3.33**	3.00	2.73	2.50	2.31	2.14	2.00	1.88	1.76
9	3.00	**3.38**	**3.07**	2.81	2.60	2.41	2.25	2.11	1.99	1.88
10	3.00	**3.41**	**3.13**	2.88	2.68	2.50	2.34	2.21	2.08	1.97

As a consequence the institutions could encourage their researchers to form groups consisting of 5 or more internal authors co-authoring with one or two external authors (bold marking). Seen from the perspective of the competing universities, they could try to avoid their researchers becoming external authors on such publications, since their award will be a meager 0.63-0.34 points (italic marking).

Thus there seem to be contradicting incentives for institutions and researchers: the former are "punished" in the BFI-system for researcher behavior that rewards the latter in terms of citations and general reputation. At least one could speculate that to the extent that the researchers are conscious about the finer details of the BFI-system, they could be caught between two contradicting award systems and that thus the BFI-system, being the most recent addition, interferes in an award system the researchers know and are used to navigating in.

Reversing the perspective and looking at this from the point of view of the individual researcher, the BFI-system looks like Table 2.

Table 2. No. of BFI credits awarded the individual researcher for a level 2 article with multiple authors from different institutions.

	No. of external authors									
No. of internal authors	0	1	2	3	4	5	6	7	8	9
1	**3.00**	**1.88**	**1.25**	0.94	0.75	0.63	0.54	0.47	0.41	0.38
2	**1.50**	**1.25**	0.94	0.75	0.63	0.54	0.47	0.41	0.38	0.34
3	1.00	0.94	0.75	0.63	0.54	0.47	0.41	0.38	0.34	0.31
4	0.75	0.75	0.63	0.54	0.47	0.41	0.38	0.34	0.31	0.29
5	0.60	0.63	0.54	0.47	0.41	0.38	0.34	0.31	0.29	0.27
6	0.50	0.54	0.47	0.41	0.38	0.34	0.31	0.29	0.27	0.25
7	0.45	0.47	0.41	0.38	0.34	0.31	0.29	0.27	0.25	0.23
8	0.38	0.41	0.38	0.34	0.31	0.29	0.27	0.25	0.23	0.22
9	0.33	0.38	0.34	0.31	0.29	0.27	0.25	0.23	0.22	0.21
10	0.30	0.34	0.31	0.29	0.27	0.25	0.23	0.22	0.21	0.2

The above table shows the number of credits awarded if an institution chooses to fractionalize the BFI credits at the individual level. Thus, calculating the individual level is possible. However, were the credits to be awarded to the individual researcher, this would have to be done manually, as the system was not designed to be used in this way.

However, should the departments choose to fractionalize the credits of a publication at the individual level – which the CRIS-system is now capable of, and which might seem the fairer approach, the award for the individual would change. This means that if a researcher wants to generate credits for her department, the incentive would be for him or her to cooperate exclusively with researchers from her own department, or to be first author on any publications written in collaboration with other departments, or to publish on his or her own. This incentive runs counter to the research strategies of both the Danish Universities and the Danish government, who aim to promote international cooperation.

Disregarding the benefits of shared authorship and the implied sharing of the workload, the individual researcher in fact earns the most points when working on his or her own. Piro, Aksne & Rørstad (2013) conclude that producing 10 articles with 10 authors is more labor intensive than producing one article with one author (Cited in: Aagaard, Bloch et al. 2014:58). Researchers seem to optimize their individual BFI credits by forming groups of no more than 4 authors, of which no more than two should be external (bold marking). In fact, the most optimal set-up seems to be achieved for all four authors, if two authors from the same institution are co-authors with two authors from a competing/collaborating institution. An alternative means of optimizing BFI points for the researchers is to form very large author groups with more than e.g. 38 members from external institutions: In that case the researcher obtains 0.1 credits. However, it seems safe to assume that the amount of work for each of the authors of such an article is quite limited. And the more authors, the less work for each.

In other words, the means for optimizing BFI credits are not the same for the institutions as for the researchers. The question that follows is then: Do researchers strive to optimize credits for the benefit of the organization, for their own benefit, or indeed at all?

This topic is in fact not new. In their recent article, Haugen and Sandnes (2016) consider the possible consequences of adding a similar bonus point system to the Norwegian Scientific Index. Since the bonus system has existed in the Danish BFI since 2009 we can contribute to the discussion by showing what the consequences of such bonus point system actually *have been* in Denmark.

Method

In order to analyze this a bit further, we have chosen our home institution the University of Southern Denmark (www.sdu.dk) as our case. In short, the University of Southern Denmark (SDU) comprises five main fields: Humanities, Science, Engineering, Social Sciences and Health Sciences. Since the Danish BFI does not distinguish between Engineering and Science (Sievertsen and Schneider 2012:19) but rather considers them as parts of the same main research area, we shall follow suit here. Furthermore, in our analysis we will exclude publications from other parts of the institution, e.g. the Library.

The number of researchers is approximately 1,200 and the university has about 32,000 students. Over the recent years it has been ranked between number 300-350 on lists like THE and QS. According to the university strategy, as formulated in 2012, one of its primary goals is to forward its faculty's participation in international cooperation including shared authorship.[2] As such, our home institution seems to be quite a 'typical case' in the Nordic countries. Furthermore, it is argued in the evaluation report of the Danish BFI that the influence of the BFI is strongest at universities where the BFI is used for distribution of funds internally. The reason for this is that the individual faculty members then feel more inclined to understand the system and therefore become capable of using it. Thus, studying the University of Southern Denmark provides a so-called 'most likely scenario': If researchers optimize the BFI, they are likely to do so at the University of Southern Denmark, since BFI is used internally for budgetary purposes (Sievertsen and Schneider 2012:34).

In our analysis we will focus on journal articles, as they currently form the cornerstone of academic publishing.

Data from Pure were extracted using the built-in report module. The number of peer reviewed research articles and reviews, number of internal and external authors on those publications, and publication year were recorded. The data were saved in excel format and will be made available at time of publication of this article.

SciVal (www.scival.com) was used to extract publication data from 2010 to 2015 from the Scopus database. We recorded the publication type, publication year, and number of authors. We only extracted data for articles, letters, reviews, and conference papers.

The list of publications was stripped of duplicate publications, based on DOI and title. If a duplicate had two different publication types (e.g. journal article and conference paper) the article was kept.

Using IDL (Interactive Data Language), which is a vector oriented programming language and software, we calculated various statistical characteristics of the publication data. IDL enables us to derive all standard statistical parameters of the data such as means, medians, standard deviations, etc. It also provides tools for

[2] "Internationalisering Af Forskning Og Administration - Syddansk Universitet," accessed February 18, 2016, http://www.sdu.dk/om_sdu/organisationen/strategi/tvaergaaende+handlinger/internationalisering+af+forskning+og+administration.

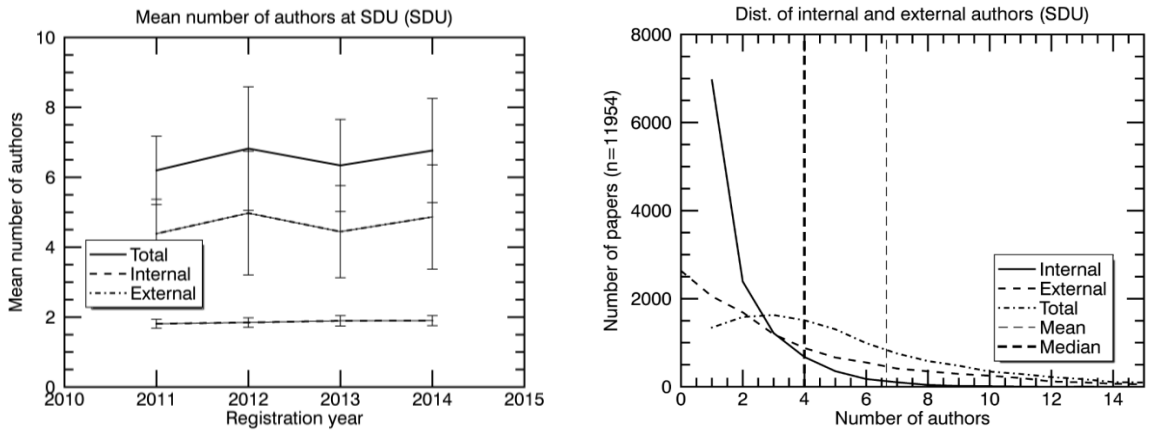
integration and derivatives of any algebraic expression of the data (cf. e.g. the IDL user's library at NASA Goddard, http://idlastro.gsfc.nasa.gov).

Results

The University of Southern Denmark has been quite successful in its strategy: According to data from SciVal[3] the number of publications per year has been steadily increasing. From 2010 to 2015 there has been a steady increase in the number of publications where one or more authors were affiliated with University of Southern Denmark: In 2010 the university produced 1873 publications, in 2015 this had increased to more than 3000. However, while the number of publications has increased, so has the average number of authors per publication. Data drawn from PURE confirm this picture. They show an increase in the number of journal articles and reviews from 2567 in 2011 to 3428 in 2015.

[3] SciVal [Internet]. [cited 2016 Aug 5]. Available from: https://www.scival.com/

Figure 1 Mean number of authors and distribution of internal and external authors University of Southern Denmark (2011-2014, journal articles)



Left graph: The mean number of authors per publication is plotted against publishing year for the total number of authors (solid curve), number of internal authors (dashed curve), and number of external authors (dashed-dotted curve). Right graph: The frequency distribution (number of papers with a certain number of authors) is plotted against the number of authors, corresponding to the total number of authors (dashed-dotted curve), number of internal authors (solid curve), and external authors (dashed curve). Also shown is the mean number of total authors (vertical thin dashed line) and the median number of total authors (vertical thick dashed line).

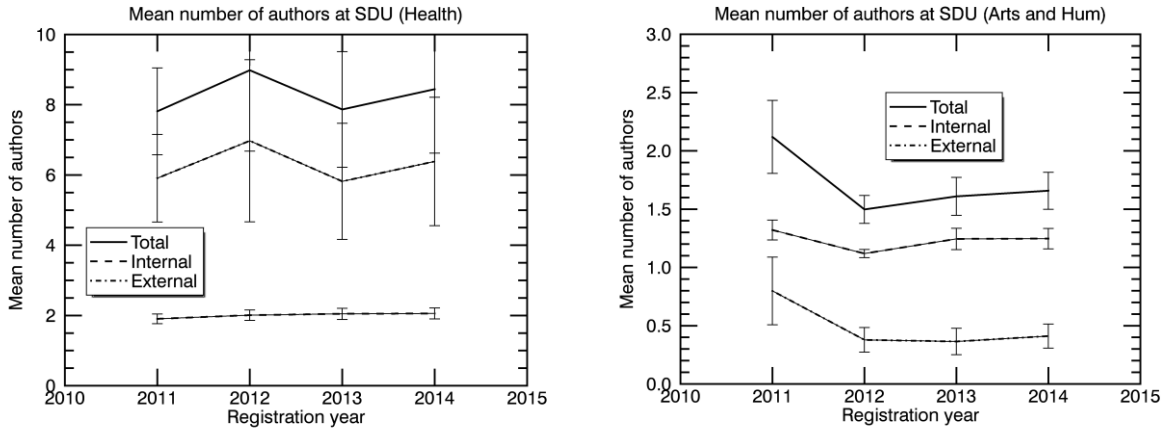
First of all we notice that the mean number of internal authors is slightly below 2 and that the data shows a very modest spread (left graph). We furthermore find that the mean number of external authors is relatively stable, although a very slight increase could perhaps be argued, but this is beyond the scope of the study presented here. Publication data from SciVal confirms the lack of a clear trend: The fractions of the total research output of the University of Southern Denmark that result from either single-author papers or papers with institutional, national or international co-authors do not display any clear trends during the period of interest. It is also important to note that the spread of data concerning the number of external authors is much larger than any trend (cf. also the right-hand graph). Correspondingly, we notice that the mean total number of authors per article is approximately 6.5. This means that the average number of authors is relatively high, e.g. when compared to the data presented by Aboukhalil (2015). According to his data based on PubMed, the average number of authors was 5.4 in 2013 and is expected to hit 8 in 2034. However, it is important to note that a relatively large share of articles have only one internal author (cf. the full curve in the right graph). Based on the figures above, one can argue that the typical article from the University of Southern Denmark has approximately two internal and four external authors.

If this is the case, then this is neither optimal for the institution nor the authors. But it has been well documented that it is difficult to conduct an analysis of publication patterns across different disciplines, since publication patterns differ (Aagaard, Bloch et al. 2014, Henriksen 2016). According to Aagaard, Bloch et al. (2014:57), the average number of authors per journal article within the Humanities is 1.4 as against 8.4 in medicine. Furthermore, our data cover some significant outliers: for instance, three articles have more than

300 authors – in fact one has 378 authors, while almost 100 (78) articles have only one author.[4] For these reasons we find it necessary to dig slightly deeper into these data and perform similar – but separate - analyses for each of the four main fields at the university.

In the following presentation of results, we have decided to present our data as a comparison between two main fields at a time. We have chosen to compare Health with Arts and Humanities and Science with Social Sciences since at first glance, they seem to share some similarities. In the analysis we will focus on the differences between the pairs and by the end of the section sum up our findings before moving on to the discussion of the results and the concluding remarks.

Figure 2 Mean number of authors. Health and Arts and Humanities, University of Southern Denmark (2011-2014, journal articles)

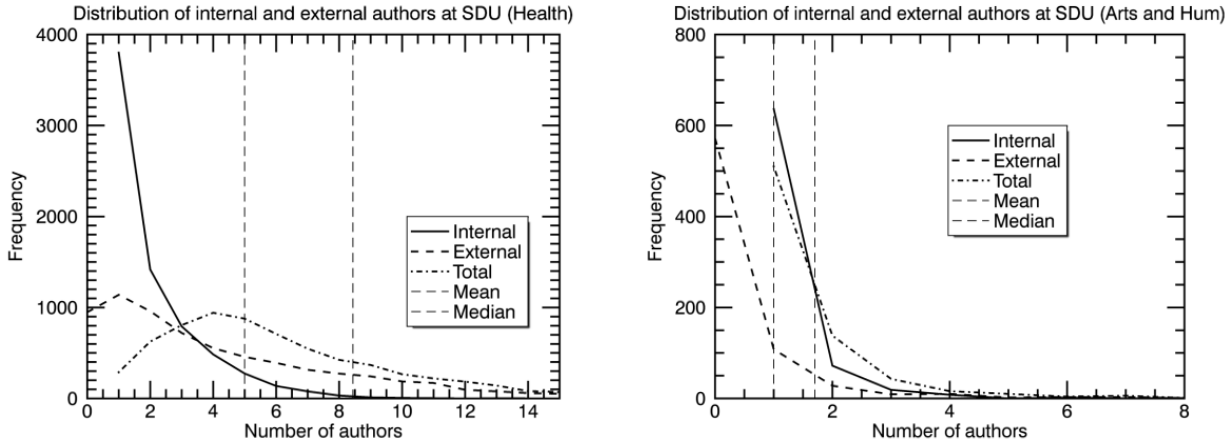


Left graph: The mean number of authors per publication within the fields of Health Science is plotted against publishing year for the total number of authors (solid curve), number of internal authors (dashed curve), and number of external authors (dashed-dotted curve). Right graph: Same approach as the left graph, but for the fields of the Arts and Humanities.

We note that the number of internal authors for both main fields remains relatively constant with very few outliers: Most articles seem to have one or two internal authors. The major difference between the two main fields concerns the number of external authors which is much higher in Health than in the Arts and Humanities. Furthermore, data on external authors in Health display quite a large spread while this does not seem to be the

[4] Aboukhalil, R. (2015). "The rising trend in authorship." The Winnower.
Describes how on article published in 2010 had 3173 authors. He argue that such mega-lists are becoming increasingly common in certain disciplines

Figure 3 Distribution of internal and external authors in Health and Arts and Humanities, University of Southern Denmark (2011-2014, journal articles)

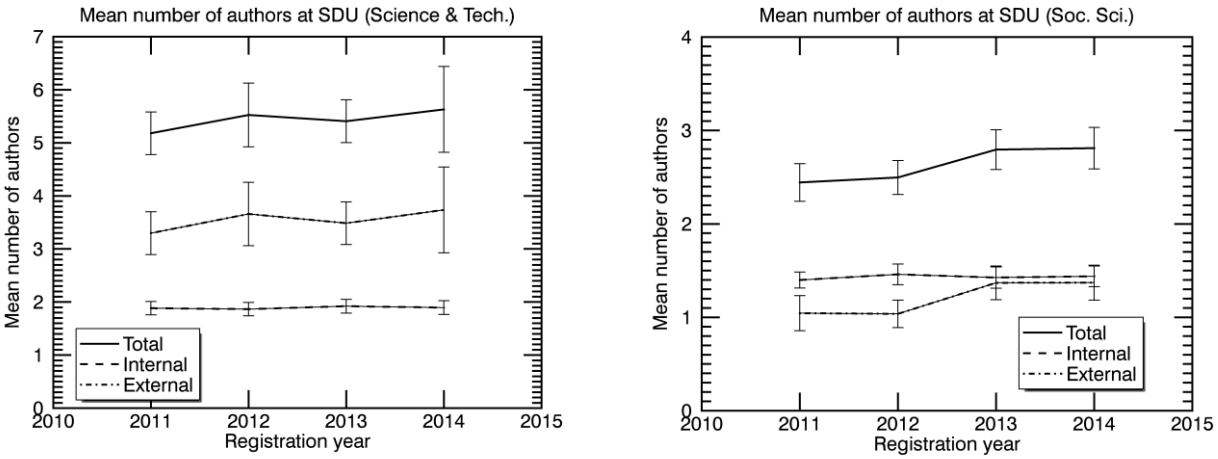


Left graph: The frequency distribution (i.e. number of papers with a certain number of authors) for the fields of Health Science is plotted against the number of authors, corresponding to the total number of authors (dashed-dotted curve), number of internal authors (solid curve), and external authors (dashed curve). Also shown are the mean number of total authors (vertical thin dashed line) and the median number of total authors (vertical thick dashed line). Right graph: Similar to the left graph, but for the fields of Arts and Humanities.

The frequencies reveal some other major differences in the publication patterns of the two main fields. Besides the obvious differences, e.g. that the mean number of authors is higher for Health and the spread of data is larger too, it becomes evident that a surprisingly large share of the journal articles in Health has only one internal author and a relatively modest share of the articles have no external authors. In the Arts and Humanities, solo authorship seems to be the rule and not the exception, and very few articles have more than one author (Marusic, Bosnjak et al. 2011). Returning to the discussion of how the different main fields optimize their BFI credits (table 1 and 2), we will argue that the Arts and Humanities optimize their BFI according to the researchers' own interests and not those of the institution (the upper left corner of table 2).

Health does not seem to optimize the BFI for the benefit of the institution or the researchers themselves: In fact, if we base this analysis of the averages alone, they do not seem to optimize at all. Since the mean number of internal authors is two and the mean number of external authors is six or seven, Health places itself in the upper right corner of table 1 and 2. However, this conclusion can probably not be firmly drawn: As evident from both figure 1 and 2, the data obtained from Health show a much larger spread, and in fact some individual researchers may be very well aware of how to optimize their BFI credits and may actually be doing so, while others may ignore this completely.

Figure 4 Mean number of authors. Science & Tech and Social Sciences, University of Southern Denmark (2011-2014, journal articles)

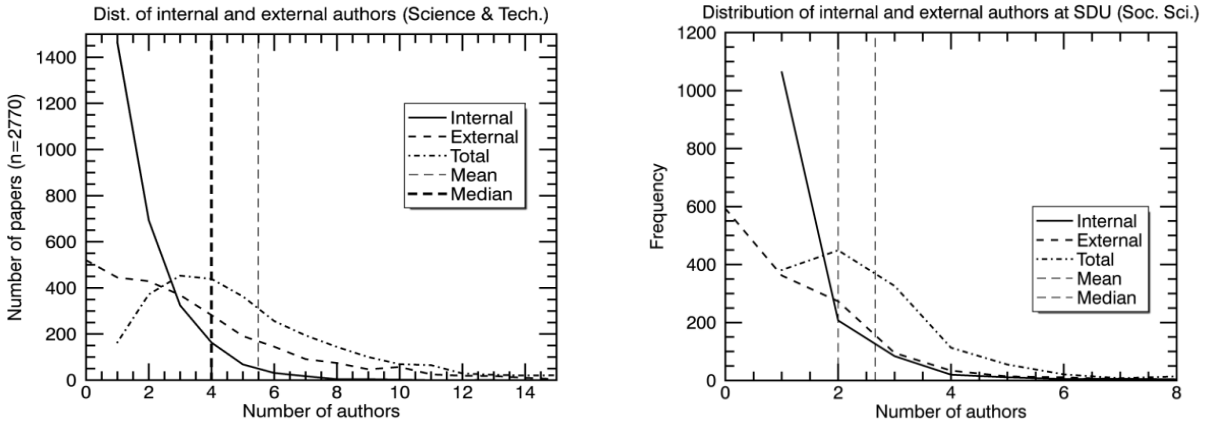


Left graph: The mean number of authors per publication within the fields of Natural Science and Technology is plotted against publishing year for the total number of authors (solid curve), number of internal authors (dashed curve), and number of external authors (dashed-dotted curve). Right graph: Same approach as the left graph, but for the fields of Social Science.

Looking first at the similarities between Science & Tech and Social Sciences, we notice that the mean numbers of authors seem to be comparable. We notice further that the number of internal authors remains constant with limited variation in both main fields. In Science, the mean number of internal authors is slightly higher (approximately two) than in the social sciences (slightly below 1.5). We may also speculate that since the number of internal authors seems to remain constant, the apparent increase could stem from an increase in the number of external authors. This would, if true, fit very well with the evaluation of the Danish BFI, which claimed that the Danish BFI enhanced research cooperation across institutional (and national) borders (Sievertsen and Schneider 2012:11).

Again, since the data show no clear evidence of change over time, we shall ourselves dig deeper into the distribution of internal and external authors for all the articles in the sample.

Figure 5 Distribution of internal and external authors in Science & Tech and Social Sciences, University of Southern Denmark (2011-2014, journal articles)

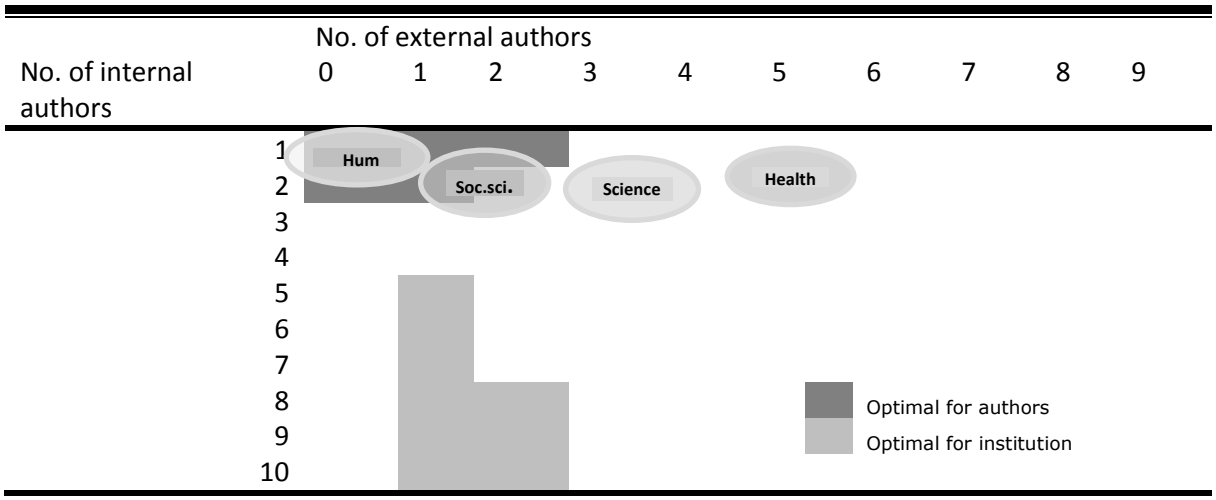


Left graph: The frequency distribution (i.e. number of papers with a certain number of authors) for the fields within Natural Science and Technology is plotted against the number of authors, corresponding to the total number of authors (dashed-dotted curve), number of internal authors (solid curve), and external authors (dashed curve). Also shown is the mean number of total authors (vertical thin dashed line) and the median number of total authors (vertical thick dashed line). Right graph: Same approach as the left graph, but for the fields within Social Science.

It is noticeable that the distribution of internal and external authors is quite similar for both faculties, except for the fact that the mean number of authors is higher for the Science Faculty than for the Social Science Faculty, and that the overall patterns resemble that of Health more than that of the Humanities (see figure 3). Based on these figures, we find it hard to argue that the Science Faculty optimizes the BFI, either in their own interests or in those of the institution. At the Faculty of Social Sciences, on the other hand, data indicate that the average article with two internal and one or two external authors actually constitutes an optimization in accordance with the interests of the faculty (and not the university as institution).

We may therefore summarize our findings on figure 6:

Figure 6 Optimal and actual distribution of authors from the four main areas



Summing up, our data indicates that none of the faculties optimize their BFI in accordance with the interests of the institution, and in fact Science and Health do not seem to optimize BFI in the interests of the individual faculty member either.

For the Social Sciences and the Arts and Humanities, our data indicates a tendency towards not optimizing in the interests of the institution.

Discussion and conclusion

Research in authorship patterns is an area that is attracting increasing attention (Marusic, Bosnjak et al. 2011, Economist 2016), and for good reasons. It has been argued that the introduction of various quantitative performance measures have increased the quantity but decreased the quality of research publications (Biggs 2013). It has also been argued that researchers are increasingly becoming experts in optimizing their own performance on the basis of quantitative performance measures, and that this is the reason why the number of authors per journal article increases at such a rapid pace that integrity and credibility of research is lost (Aboukhalil 2015).

But this does not seem to reflect the reality of our case university. The SDU scientific community has apparently remained relatively immune to these measures: The changes in authorship patterns that in our data reflect are few and relatively insignificant, though our data does not allow for statistical significance tests. According to Sievertsen and Schneider (2012), the introduction of the Danish BFI has meant an increase in the number of publications per researcher and an increase in the number of authors per journal article. We disagree, however, for it does not seem fair to claim that this development is caused by the introduction of the BFI with its incentives for sharing authorship across institutions: In comparison, the Norwegian BFI has only recently introduced a built-in incentive for cooperation between researchers similar to the Danish one (Haugen and Sandnes 2016). Even so, the development in authorship patterns in Norway has been parallel to the Danish one (Aagaard, Bloch et al. 2014:48). In other words, the changes in authorship patterns seem to originate in systemic conditions rather than in the incentives of the BFI (Aagaard, Bloch et al. 2014: 83).

One question seems to remain: Is the finding that author group composition within the Social Sciences and the Arts and Humanities is more likely to be optimized to earn BFI credits than author group composition in Health and Science a mere coincidence based on different publication strategies and traditions, or are there reasons to assume that researchers in the Social Sciences and the Arts and Humanities actually use the BFI strategically in order to optimize their individual BFI?

Unfortunately, our data cannot provide us with an unequivocal answer to this question. Aagaard, Bloch et al. (2014: 78) argue that since quantitative measures for research performance have been the norm within Health and Science for many years, the introduction of the BFI has had a relatively limited effect within these areas. But since such quantitative performance measures were relatively new to the Social Sciences and the Humanities, the effects there have been much stronger.

Aagaard, Bloch et al. (2014) and Sievertsen and Schneider (2012) argue further that especially in the Social Sciences and the Humanities, BFI is increasingly taken into consideration when decisions are made on the distribution of privileges and funds among individual faculty members (Aagaard, Bloch et al. 2014:98), and that at several institutions, the amount of earned BFI credits is used locally for allocation of research time and funds (Aagaard, Bloch et al. 2014: 78). Therefore Aagaard, Bloch et al. (2014: 9) argue " […] that the incentives are quite strong down through the institutions. This is not least through monitoring at the individual levels […]".

Unfortunately, our data does not allow us to draw any clear conclusion on this matter, but we note a difference in the extent to which Social Scientists and faculty in the Arts and Humanities utilize the incentives created by the BFI to cooperate, and that these faculties seem more likely to optimize BFI credits in their own interests than in those of the institutions.

Furthermore, we will argue that as the system works, universities are awarded fewer credits when the authors collaborate across institutions than if they choose to work alone or in collaboration with colleagues from their home institution. Thus the researchers are caught between a rock and a hard place; should they optimize for BFI credits which benefit their home institution, or should they optimize for citations which benefit their own careers?

This may all seem quite speculative since our analysis indicates that researchers have not changed their publication behavior significantly after the introduction of the BFI. However, this may change if Danish universities decide to award individual researchers with funds based on their annual BFI credit production. In that case, researchers will face these contradicting incentives: Should they collaborate and get more citations, or should they work alone or only within their home institution and get more BFI credits? We argue that placing the research community in this situation is not helpful for advancing and improving Danish research; on the contrary, it may damage the underlying incentive all researchers work by: their inner motivation. Such a development can, however, be avoided, provided that a substantial effort is put into developing models at the lower institutional levels that combines the earned BFI credits with other indicators. In summary, we acknowledge that the Danish BFI and the Norwegian NSI may create counter-productive incentives for researchers who share authorships as indicated by Haugen and Sandnes (2016). However, we remain less pessimistic: Only if BFI/NSI is used to calculate researcher performance on an individual level do we foresee that researchers will be facing contradicting incentives.

References

Aboukhalil, R. (2015). "The rising trend in authorship." The Winnower.

Aksnes, D. W. (2003). "Characteristics of highly cited papers." Research Evaluation **12**(3): 159-170.

Bartneck, C. and J. Hu (2010). "The fruits of collaboration in a multidisciplinary field." Scientometrics **85**(1): 41-52.

Biggs, S. (2013). "Editorial: R and K strategies and the proliferation of scientific papers." Pacific Conservation Biology: 92-93.

Costas, R. and C. v. Bochove On the Relationship between Author Collaboration and Impact of Scientific Publications.

Economist, T. (2016). All together now - Why research papers have so many authors. The Economist. www, economist.com. [Accessed November 28th]

Faurbæk, L. (2008). "Notat til: Styregruppen for den bibliometriske forskningsindikator." 14-07-2016, from http://ufm.dk/forskning-og-innovation/statistik-og-analyser/den-bibliometriske-forskningsindikator/fraktionering/beslutning-om-fraktionering.pdf.

Faurbæk, L. (2013). "Fraktionering." Retrieved 14-07-2016, 2016, from http://ufm.dk/forskning-og-innovation/statistik-og-analyser/den-bibliometriske-forskningsindikator/fraktionering.

Haugen, K. K. and F. E. Sandnes (2016). "The new Norwegian incentive system for publication: from bad to worse." Scientometrics **109**: 1299-1306.

Henriksen, D. (2016). "The rise in co-authorship in the social sciences (1980-2013)." Scientometrics.

Hurley, L. A., et al. (2013). "Deconstructing the collaborative impact: Article and author characteristics that influence citation count: Deconstructing the Collaborative Impact: Article and Author Characteristics that Influence Citation Count." Proceedings of the American Society for Information Science and Technology **50**(1): 1-10.

Marusic, A., et al. (2011). "A systematic Review of Research on the Meaning, Ethics and Practices of Authorship across Scholary Disciplines." PLoS One **6**(9).

Pislyakov, V. and E. Shukshina (2014). "Measuring excellence in Russia: Highly cited papers, leading institutions, patterns of national and international collaboration." Journal of the Association for Information Science and Technology **65**(11): 2321-2330.

Sievertsen, G. and J. Schneider (2012). Evaluering av den bibliometriske forskningsindicator Nordisk Institutt for studier av innovasion, forskning og utdanning**:** 75.

Sin, S.-C. J. (2011). "International coauthorship and citation impact: A bibliometric study of six LIS journals, 1980-2008." Journal of the American Society for Information Science and Technology **62**(9): 1770-1783.

Thijs, B., et al. (2015). "Multi-authorship and citation advantage, a mythical relationship."

Aagaard, K., et al. (2014). Evaluering af den norske publiceringsindikator. Aarhus, Insititut for Statskundskab, Aarhus University.

[i] http://library.au.dk/en/subject-areas/agriculture-and-environment/the-bibliometric-research-indicator/